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Developing Beam Phasing on the Nova Laser

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The National Ignition Facility will require beam phasing for time-dependent control of x-ray flux symmetry on target to achieve high convergence implosions[1]. We are presently adding the capability to irradiate indirectly driven Nova targets with two rings on each side, each nearly uniform in the azimuthal dimension for beam phasing studies of time-dependent second Legendre and time-integrated fourth Legendre (P_4) flux asymmetry control. We present recent calculations which show a factor of three improvement in time-dependent flux asymmetry swings with four-cone beam-phasing. In addition, increasing the cone separation from zero to 300 μm is predicted to lead to nearly a factor of three decrease in time-integrated P_4 flux asymmetry.

The timing and pulse shape of the outer rings of light illuminating the targets will be controlled independently from those of the inner rings. Each pair of rings could have virtually any Nova pulse shape[2]. The pulse shapes will be generated with the current main beamline pulse shaper and the backlighter pulse shaper. We present results of a limited demonstration of injecting one pulse shape into one side of each Nova beamline while the other pulse shape is injected into the other half of each beamline. Several beams will be rotated at the front end of the laser chain to make the orientation of the beam footprints consistent on target. Most of the hardware required to accomplish the beam rotation has already been installed, as it has been designed in conjunction with beam smoothing of all ten beams[3]. Both the separation of each beam into two parts on target and the formation of ring shapes will be achieved with specially designed kinoform phase plates (KPPs)[4].

Precision pointing and power balance capabilities will be important to beam-phasing experiments. Experience with performing pointing calibration measurements with binary random phase plates shows that the KPPs should not significantly affect our ability to maintain a pointing accuracy of 35 μm rms among the ten beams. We are making modifications to the incident beam diagnostics to determine the power vs. time in each half of the beams. Separate diodes will measure the energy in each half of the beams, with a redundant diode measuring the total energy in each beam. The signal from fast diodes coupled into 6 GHz transient digitizers will provide the temporal profile of one half of each beam, while a streak camera records the temporal profile of the sum of the halves. Increased calibration uncertainties will likely increase power balance errors to 7% rms in the peak and 12% rms in the "foot" of shaped pulses.

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